

TO: Director, National Institute for Occupational Safety and Health

FROM: California Fatality Assessment and Control Evaluation (FACE) Program

SUBJECT: Fitter/welder is crushed between two pressure vessels and dies in California

SUMMARY

California FACE Report #99CA010

A 42-year old male fitter/welder (decedent) died when he was crushed between a stationary pressure vessel (a type of unfired, cylindrical tank) and a pressure vessel that had tipped up. The decedent was on top of the pressure vessel that tipped while he was welding a seam on a manway (personnel hatch). The pressure vessel he was on was lying lengthwise cradled in devices called positioners. This pressure vessel suddenly tipped up. He was thrown off and crushed between the tipping pressure vessel and an adjacent pressure vessel. The pressure vessel that tipped had one of the two heads (a type of end cap) welded into place. It was heavy on that end and the positioner was placed so that any additional weight on that end would easily cause it to tip. The decedent was not safeguarded by fall protection. The CA/FACE investigator determined that, in order to prevent future occurrences, employers should as part of their Injury and Illness Prevention Program (IIPP):

- . ensure employees place the positioners so that pressure vessels will not tip under minor, additional loads.
- . ensure employees use fall protection or an alternate means of access to work when working at heights.
- . develop a method for welding on shorter pressure vessels that reduces the possibility of tipping.

INTRODUCTION

On August 26, 1999 at 7:20 a.m. a 42-year-old male fitter/welder was fatally crushed between a stationary pressure vessel and a pressure vessel that had tipped up. The decedent was welding a seam on a manway on top of the pressure vessel. The pressure vessel suddenly tipped up and threw the decedent between the two pressure vessels. The CA/FACE investigator learned

of this incident on August 26, 1999 from the local district office of the California Department of Industrial Relations, Division of Occupational Safety & Health (Cal/OSHA). On September 8, 1999 the CA/FACE investigator traveled to the incident site where he interviewed the company's safety consultant and the company owner. The CA/FACE investigator took photographs of the site and pressure vessels similar to those involved in the incident.

The employer, a pressure vessel manufacturer, had been in business for 5 years at the time of the incident. The number of employees in the company was 45, with 35 employees working on site at the time of the incident. The decedent had worked for the company for 3 years and 9 months at the time of the incident. The company has a written Injury and Illness Prevention Program (IIPP), an IIPP implementation guide, and a code of safe practices. The company has a new employee orientation program which each employee has to successfully complete prior to working. The employer has written Job Safety Analyses (JSAs) for the various tasks the employees perform. The company provides general and specific training for employees using the JSAs, company trainers, and outside consultants. A safety and health suggestion plan is available and employee input is encouraged. The owner, who stated that he was responsible for overall safety in the company, indicated that each supervisor is responsible for the safety of employees they directly supervise. Regularly scheduled safety meetings are held weekly and, if determined to be necessary, at the beginning of new projects. An outside consultant holds formal, monthly safety meetings.

INVESTIGATION

The site of the investigation is a manufacturing facility which has several partially open bays of differing sizes. Each bay has a bridge crane used in lifting construction materials and pressure vessels. Welding machines (**exhibit 1**) and apparatus are supplied to each area within the bay. Small stacks of plate steel of differing thickness used in constructing the pressure vessels are located throughout the facility. Custom specifications provided by each buyer determines the type of pressure vessel to be built.

Rolls (a metal forming machine that uses rollers) are used to form the plate steel into a cylinder (**exhibit 2**). For longer pressure vessels, cylinders are welded together until the proper length is achieved. When the plate steel is completely welded as a cylinder, fittings (**exhibit 3**) and heads (**exhibit 4**) (a type of convex end cap) are welded to each end of the cylinder. Legs are also welded onto the cylinder for both upright (vertical) and horizontal cylinders.

Prior to the day of the incident, a cylinder 83 1/2 inches long and 12 feet in diameter had been welded. One head (end cap) had been welded onto the west-facing end. The east-facing end was still open. The cylinder by itself weighed 6,729 pounds while the head weighed 3,925 pounds. When completed, with both heads in place, this pressure vessel would be 121 inches long. In order to weld the pressure vessel, it was cradled in two positioners (**exhibit 5**). Each positioner was a concave device with a roller on each end. One of the rollers was powered by an electric motor which was used to slowly turn the pressure vessel as welding of the seams took place. An unknown number of fittings had already been welded onto the shell of the cylinder. The positioners had been placed to support the cylinder while not interfering with the fittings as the cylinder rotated.

On the day of the incident, the decedent was on top of the cylinder welding on a seam of a manway (personnel hatch). The cylinder was not rotating at the time. While welding on the

hatch, the pressure vessel suddenly flipped upright with its head toward the floor and the open end toward the ceiling.

The decedent was thrown off toward the west. He was crushed when he entered the area between the shell of the cylinder that had flipped up and the head which had been welded onto the east end of the adjacent pressure vessel.

CAUSE OF DEATH

The death certificate stated the cause of death to be multiple traumatic injuries.

RECOMMENDATIONS/DISCUSSION

Recommendation #1: Employers should ensure employees place the positioners so that pressure vessels will not tip under minor, additional loads.

Discussion: In this incident the positioners were placed so that the pressure vessel would tip if any small, additional load was placed near the heavy end. If the decedent moved toward the west end of the pressure vessel his weight may have been enough to upset the vessel. In order to assure that pressure vessels are supported in a manner resistant to tipping, the center of gravity and the range of safe placement should be determined and clearly marked on the pressure vessel. The positioners could then be accurately placed so that work could be performed without the possibility of upset of the pressure vessel. If the pressure vessel had been better supported this incident most likely would not have happened.

Recommendation #2: Employers should ensure employees use fall protection or an alternate means of access to work when working at heights.

Discussion: The decedent was not wearing fall protection or otherwise protected from falling while he was welding on the manway. When working at heights employees must be protected from falling. A personal fall protection system could be used if the free fall is no more than four (4) feet before the fall is arrested. Alternatively, a platform could be used to gain access to the work site or an aerial lift could be used. If possible, the cylinder should be rotated so that the work needing welding can be done at floor level. If the decedent was protected from falling, this incident may not have happened.

Recommendation #3: Employers should develop a method for welding on shorter pressure vessels that reduces the possibility of tipping.

Discussion: Considering the length, diameter and weight of the pressure vessel involved in this incident, it is apparent that properly supporting the pressure vessel to prevent tipping is difficult. This is especially true when one considers that the fittings welded to the shell may dictate the placement of the positioners. In this instance, the positioner on the west end of the pressure vessel that tipped should have been as close as possible to the end due to the weight of the head that had been previously welded in place. In order to prevent tipping, this employer, when working on shorter pressure vessels, now attaches two heads together. This is done by tack welding each end of an open, small cylinder to one of the heads. The heads are placed, one on the west end of one vessel, and one on the east end of the other (**exhibit 6**). This effectively doubles the length of a single pressure vessel and allows the placement of four positioners underneath. This would substantially reduce the possibility of tipping.

References:

Barclays Official California Code of Regulations, Vol. 9, Title 8, Industrial Relations, South San Francisco, 1998

For general information regarding fall protection, platforms, and securing equipment refer to:
<http://www.dir.ca.gov/title8/1661.html>; [/1670.html](http://www.dir.ca.gov/title8/1670.html); [/1671.html](http://www.dir.ca.gov/title8/1671.html); [/1671.1.html](http://www.dir.ca.gov/title8/1671.1.html); [/3210.html](http://www.dir.ca.gov/title8/3210.html);
[/3241.html](http://www.dir.ca.gov/title8/3241.html); [3273.html](http://www.dir.ca.gov/title8/3273.html); [/3299.html](http://www.dir.ca.gov/title8/3299.html); [/3328.html](http://www.dir.ca.gov/title8/3328.html)

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March 2, 2000

FATALITY ASSESSMENT AND CONTROL EVALUATION PROGRAM

The California Department of Health Services, in cooperation with the California Public Health Institute, and the National Institute for Occupational Safety and Health (NIOSH), conducts investigations on work-related fatalities. The goal of this program, known as the California Fatality Assessment and Control Evaluation (CA/FACE), is to prevent fatal work injuries in the future. CA/FACE aims to achieve this goal by studying the work environment, the worker, the task the worker was performing, the tools the worker was using, the energy exchange resulting in fatal injury, and the role of management in controlling how these factors interact.

NIOSH funded state-based FACE programs include: Alaska, California, Iowa, Kentucky, Maryland, Massachusetts, Maryland, Minnesota, Missouri, Nebraska, New Jersey, Ohio, Oklahoma, Texas, Washington, West Virginia, and Wisconsin.

Additional information regarding the CA/FACE program is available from:

California FACE Program

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